

01-24-00

A

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

"EXPRESS MAIL" MAILING LABEL

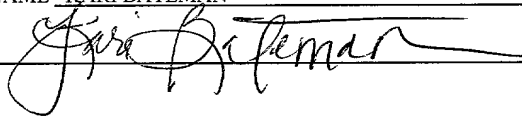
NUMBER EL 173827617 US

DATE OF DEPOSIT January 21, 2000

I HEREBY CERTIFY THAT THIS PAPER OR FEE IS BEING DEPOSITED WITH THE UNITED STATES POSTAL SERVICE "EXPRESS MAIL POST OFFICE TO ADDRESSEE" SERVICE UNDER 37 CFR 1.10 ON THE DATE INDICATED ABOVE AND IS ADDRESSED TO: THE ASSISTANT COMMISSIONER FOR PATENTS, WASHINGTON, DC 20231.

TYPED NAME KARI BATEMAN

SIGNED



01/21/00  
jc690 U.S. PTO  
File No. January 21, 2000

File No. A-67845/JAS

Assistant Commissioner for Patents  
Washington, DC 20231

Sir:

Transmitted herewith for filing is the patent application of Inventor(s):

**Dirk A. Krieger, Klaus Kloppel, Etoli Wolff, Steven N. Parsoneault and Don J. MacLeod**

Title: ***Hydrodynamic Spindle Motor Sealing Technique***

Enclosed are also:

☐ Prior Art Statement

☒ 2 Sheets of drawings, Formal   , Informal XX

☐ An Assignment of the invention to:                                 

☐ Power of Attorney by Assignee

☐ (Unsigned) Declaration for Patent Application

☐ Small Entity Status Declaration Under 37 CFR                                 

jc564 U.S. PTO  
09/489293  
01/21/00

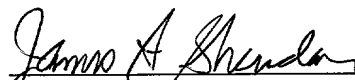
	(Col. 1) NO. FILED	(Col. 2) NO. EXTRA	SMALL ENTITY RATE	FEE	OTHER THAN SMALL ENTITY RATE	FEE
<b>BASIC FEE</b>				\$		\$690
<b>TOTAL CLAIMS</b>	<u>8</u> - 20	0	x 9 =	\$	x 18 =	\$ 0
<b>INDEP CLAIMS</b>	<u>2</u> - 3	0	x 39 =	\$	x 78 =	\$ 0
<b>MULTIPLE DEPENDENT CLAIM PRESENTED</b>			+130 =	\$	+260 =	\$
If the difference in Col 1 is less than zero, enter "0" in Col. 2			<b>TOTAL</b>	\$	<b>TOTAL</b>	\$ 690

☒ Our Check No. 0005180 in the amount of \$ 690.00 to cover the filing fee is enclosed.

☒ This application claims priority to U.S. Provisional Patent Application Serial No. 60/116,756 filed January 22, 1999.

☒ The Commissioner is hereby authorized to charge any additional fees which may be required, including extension fees, or credit any overpayment to Deposit Account No. 06-1300 (Order No. A-67845/JAS). **A copy of this sheet is enclosed for such purpose.**

Respectfully submitted,



James A. Sheridan, Reg. No. 25,435

FLEHR HOHBACH TEST ALBRITTON & HERBERT LLP  
Four Embarcadero Center, Suite 3400  
San Francisco, California 94111-4187  
Telephone: (650) 494-8700 Fax: (650) 494-8771  
1003771

## HYDRODYNAMIC SPINDLE MOTOR SEALING TECHNIQUE

10

### Cross-Reference to a Related Application

This application claims priority to provisional application, Serial No. 60/116,756 filed January 22, 1999 and assigned to the assignee of this application; the priority of this provisional application is hereby claimed.

15

### Field of the Invention

The present invention relates to hydrodynamic bearing motors and more specifically to method and structure for successfully sealing such a motor.

20

### Background of the Invention

Magnetic disc drives are used for magnetically storing information. In a magnetic disc drive, a magnetic disc rotates at high speed and a transducing head flies over the surface of the disc. This transducing head records information on the disc surface by impressing a magnetic field on the disc. Information is read back using the head by detecting magnetization of the disc surface. The transducing head is moved radially across the surface of the disc so that different grades of tracks can be read back.

25

30

35

Over the years, storage density has increased and the size of the storage system has decreased. This trend has lead to greater precision and lower tolerance in the manufacturing and operating of magnetic storage discs. For example, to achieve increased storage densities, the transducing head must be placed increasingly close to the surface of the disc. This proximity requires that the disc rotate substantially on a single plane. A slight wobble or run out in disc rotation can cause the surface of the disc to contact the transducing head. This is known as a crash and can damage the transducing head surface of the storage disc, resulting in loss of data.

5 From the foregoing discussion, it can be seen that the varying assembly which supports the disc is of critical importance. For this reason, substantial research work has been done on the development of hydrodynamic bearings. In such a bearing, a lubricating fluid, such as air liquid, provides a bearing surface between a fixed member of the housing and a rotating member of the disc hub. Hydrodynamic  
10 bearings spread the bearing interface over a large surface area in comparison with the ball bearing assembly, reducing wobble or run out between the rotating and fixed members. Further, shock resistance and ruggedness is improved. Further, the use of fluid in the interface area imparts damping effects to the bearing which helps to reduce nonrepeat run out. However, the bearings themselves, because of the  
15 inclusion of the fluids, must be sealed so that the fluid cannot leak or disburse into the atmosphere surrounding the bearing and motor. Such leakage can contaminate either the disc or the transducer, dramatically reducing the life of the disc drive.

Currently assembly processes in sealing the end of the motor where the shaft terminates, typically supporting a thrust plate, will require the use of a absorbent  
20 compressible o-ring inserted in a groove which must be machined in the sleeves surrounding the shaft. A counterplate and washer or similar are required to hold the o-ring in place.

However, there are several potential downfalls of the o-ring method. Because some fluid leakage is possible between the end of the sleeve and the counterplate which rests against the sleeve and presses the o-ring in place, the o-ring can saturate,  
25 allowing some future loss of fluid beyond this saturation point. Further, there can be some loss by evaporation from the saturated o-ring. Finally, the o-ring demands extra lateral spacing in the hub, as well as machining of a o-ring groove, together with the cost of the o-ring itself.

30 Therefore, a better sealing technique is needed.

5        Summary of the Invention

          The present invention is intended to overcome many of the deficiencies inherent in the prior art. More specifically, the present invention, which comprises a shaft with a thrust plate at one end, directly welds the counterplate which lies across the end of the shaft to an extension of the sleeve in which the counterplate is fit. In this way, the o-ring, and the sealing washer, which had to be incorporated into the prior art, are both deleted. This results in a more robust, less expensive and higher quality motor.

10       Brief Description of the Drawings

          FIG. 1 is a sectional view which illustrates in part the prior art design, and illustrates in further part an example of the new invention.

          FIG. 2 is a vertical sectional view of a typical spindle motor for a disc drive incorporating the present invention.

15       Detailed Description of a Preferred Embodiment

          The present invention is intended to more efficiently and economically seal a hydrodynamic bearing incorporated within a spindle motor such as is used in a disc drive or the like, where contaminants or gases generated within the bearing must be prevented from exiting the bearing gap region.

20       Referring to FIG. 1, especially the left-hand side thereof, the basic elements of a typical spindle motor include a fixed shaft 10 which supports for rotation a sleeve 12 having a hub or the like 14 which has a flange 16 capable of supporting one or more disc for rotation thereon. A thrust plate 20 is supported at one end of the shaft, with the hydrodynamic bearing or bearings 22 extending both axially along the surface of the shaft and radially along both surfaces 24, 26 of the thrust plate to enhance the radial and axial stability of the system. The fluid (not shown) of the system is maintained in the reservoir 30 inside the central shaft 10, and circulates over the surfaces and through the gap between the shaft 22 and the sleeve 12 as

5 well as the thrust plate surface 26 and the sleeve 12 and the thrust plate surface 24  
and the counterplate 32. In order to prevent any loss of fluid from the gap, it must  
not be allowed to escape between the upright portion 40 of the sleeve and the facing  
surface of the counterplate 32. For this reason, the prior art has proposed and utilized  
a o-ring 42 which rests in a groove 44 in the surface of the sleeve facing the  
10 counterplate 32. However, this approach requires both the expense of forming the  
groove 44 in the sleeve, as well as the cost of the o-ring 42 and the equipment time  
to insert the o-ring 42 in the groove. Further, in order to maintain the compression  
of the o-ring and diminish the possibility of fluid escaping, in addition to the  
counterplate facing the o-ring, a further washer 50 must be used and held in place  
15 against the counterplate.

An additional difficulty is that some additional lateral or radial width in the  
sleeve 12 is required in order to accommodate the o-ring 42 radially spaced from  
the thrust plate 24.

To eliminate this possibility, it has been proposed as shown schematically  
20 on the right side of FIG. 1, that the o-ring 42 and its groove 44 be replaced or  
eliminated, as well as the washer 50. It can immediately be seen from a comparison  
of the left and right sides of FIG. 1, that this diminishes the radial spacing of the  
sleeve 12, as well as eliminating the need for a machining step to create the groove,  
and reducing the part count by eliminating both the o-ring 42 and the washer 50.

25 Details of implementing this approach are found in FIG. 2.

FIG. 2 shows a design which in contrast to FIG. 1 is a rotating shaft 100  
as the shaft is integrated with the hub 102 which carries flange 104 which functions  
as a disc support surface. The shaft with the hub 102 supports a magnet 104 on  
its inner axial surface, facing stator 106 whose energization causes stable rotation  
30 of the hub. The stator in turn is supported on a axial extension 108 of base casting  
110. A sleeve 112 which supports the shaft 100 and its associated thrust plate 116  
is incorporated into the axial extension 108 of the base 110. This sleeve 112 has  
axial surface 120 that faces a surface of the shaft. These two surfaces define a journal

5 bearing which is of standard design and not further shown. Further, the thrust plate  
at surfaces 122 and 124 define in cooperation with the sleeve 112 and the  
counterplate 130 thrust bearings of the fluid dynamic type which further support  
the shaft against both axial and radial forces. Each of these journals and thrust  
10 bearings require fluid in the gap between the facing surfaces. This fluid may either  
recirculate through an internal channel 134 which either passes through the thrust  
plate or between the thrust plate and shaft, or return through a central reservoir or  
the like such as the reservoir 30 shown in FIG. 1. In either case, a primary cause  
for concern is with the old design of FIG. 1 is to prevent the escape of any fluid  
15 between the surface 140 of the sleeve and the complementary surface 142 of the  
thrust plate. To avoid this loss, while enhancing the simplicity of the design, a laser  
weld has been applied at the junction at the axially outer edge of the thrust plate  
130 and the sleeve 112. This laser weld is applied using well-known techniques  
and technology but by its very simplicity enhances the reliability.

20 This simple appearing change provides a better sealing technique and a more  
robust, less expensive and higher quality motor. It eliminates the need for the O-ring  
42 and the O-ring groove 44 which appear in FIG. 1, as well as the center washer  
50 which is integral to maintaining the counterplates sealed tightly against the  
washer. It eliminates the radial space requirement for the O-ring, and even simplifies  
the dimension of the counterplate relative to the axial arm 160 of the sleeve 112.  
25 It also provides for easier oil filling.

This invention eliminates the axial play which relates to pinched O-rings,  
and diminishes the possibility of O-ring oil absorption and O-ring leakage.

Other features and advantages of this invention will be apparent to a person  
of skill in the art who studies this invention disclosure. Therefore, the scope of the  
30 invention is to be limited only by the following claims.

5       **WHAT IS CLAIMED IS:**

1.       A spindle motor for use in a disc drive comprising  
          a shaft supporting a thrust plate at one end thereof,  
          a sleeve surrounding the shaft and adjacent the thrust plate and cooperating  
10       with the shaft to define a journal bearing and the thrust plate to define a first fluid  
          thrust bearing,  
          a counterplate welded to upraised axial arms of said sleeve and located  
          adjacent said thrust plate to define a second fluid dynamic thrust bearing,  
          the welded counterplate containing fluid within the thrust bearings and the  
15       journal bearing.
2.       A spindle motor as claimed in claim 1 wherein the shaft is fixed and the  
          sleeve and counterplate rotate relative to the shaft.
- 20       3.       A spindle motor as claimed in claim 2 wherein the sleeve supports a hub  
          for supporting a disc for rotation about the shaft.
- 25       4.       A spindle motor as claimed in claim 1 wherein the shaft is free to rotate  
          relative to the sleeve and counterplate.
- 30       5.       A spindle motor as claimed in claim 4 wherein the sleeve and counterplate  
          are fixed to a base which supports the motor.
6.       A spindle motor as claimed in claim 5 wherein the shaft supports a hub for  
          rotation over said base.
7.       A spindle motor as claimed in claim 6 wherein the hub supports one or more  
          discs for rotation.

8. A spindle motor for use in a disc drive comprising  
a shaft supporting a thrust plate at one end thereof,  
a sleeve surrounding the shaft and adjacent the thrust plate and cooperating  
with the shaft to define a journal bearing and the thrust plate to define a first fluid  
thrust bearing,

a counterplate supported between upraised axial arms of said sleeve and located adjacent said thrust plate to define a second fluid dynamic thrust bearing, means for containing fluid within the thrust bearings and the journal bearing.

$\begin{Bmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 10 & 11 & 12 & 13 & 14 & 15 & 16 & 17 & 18 & 19 & 20 & 21 & 22 & 23 & 24 & 25 & 26 & 27 & 28 & 29 & 30 & 31 & 32 & 33 & 34 & 35 & 36 & 37 & 38 & 39 & 40 & 41 & 42 & 43 & 44 & 45 & 46 & 47 & 48 & 49 & 50 & 51 & 52 & 53 & 54 & 55 & 56 & 57 & 58 & 59 & 60 & 61 & 62 & 63 & 64 & 65 & 66 & 67 & 68 & 69 & 70 & 71 & 72 & 73 & 74 & 75 & 76 & 77 & 78 & 79 & 80 & 81 & 82 & 83 & 84 & 85 & 86 & 87 & 88 & 89 & 90 & 91 & 92 & 93 & 94 & 95 & 96 & 97 & 98 & 99 & 100 \end{Bmatrix}$



### Abstract of the Disclosure

A-67845/JAS

1003249

OFFICE OF THE COMPTROLLER

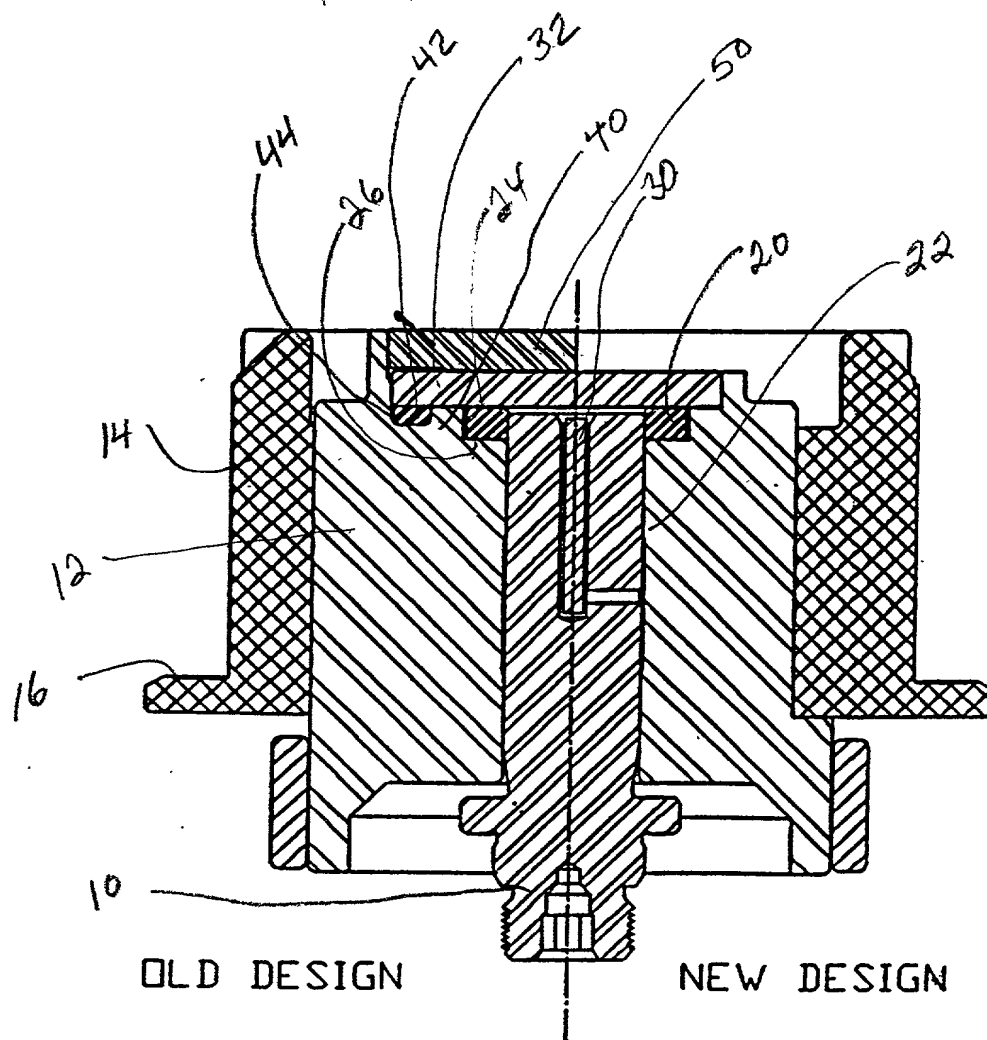
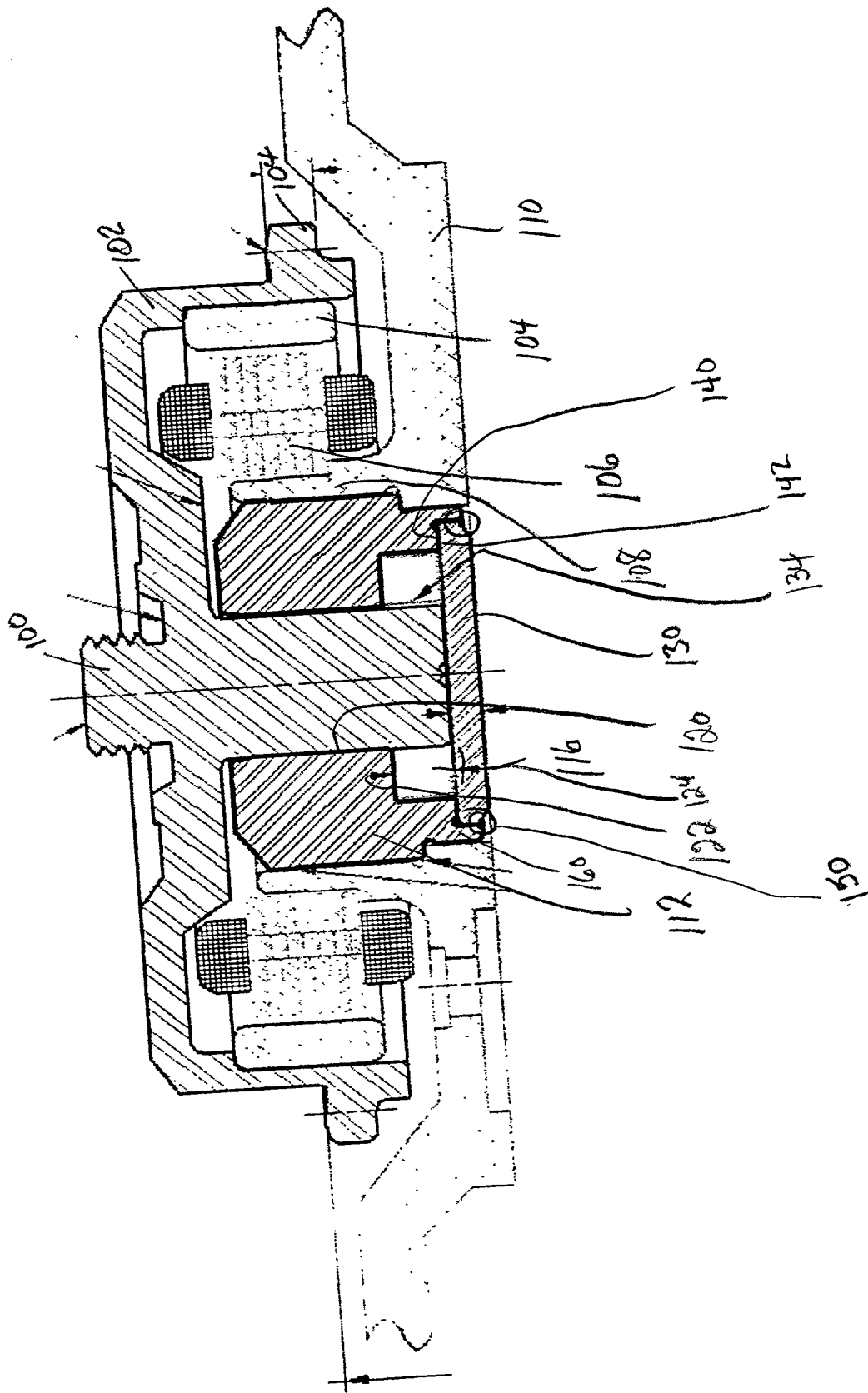


FIG. 1



## DECLARATION FOR PATENT APPLICATION

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled HYDRODYNAMIC SPINDLE MOTOR SEALING TECHNIQUE, the specification of which:

(check one) ☒ is attached hereto.  
☐ was filed on \_\_\_\_\_ as  
Application Serial No. \_\_\_\_\_  
and was amended on \_\_\_\_\_.  
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the Patent Office all information known to me to be material to patentability as defined in 37 C.F.R. 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
_____	_____	_____	<input type="checkbox"/>	<input type="checkbox"/>
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
_____	_____	_____	<input type="checkbox"/>	<input type="checkbox"/>
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose to the Patent Office all information known to me to be material to patentability as defined in 37 C.F.R. 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

<u>60/116,756</u>	<u>January 22, 1999</u>	<u>Abandoned</u>
(Application Serial No.)	(Filing Date)	(Status)
		(patented, pending, abandoned)
_____	_____	_____
(Application Serial No.)	(Filing Date)	(Status)
		(patented, pending, abandoned)

Full name of third inventor Etoli Wolff

Inventor's signature: \_\_\_\_\_

Date: \_\_\_\_\_

Residence: Sunnyvale, California

Citizenship: Israel

Post Office Address: 1575 Tenaka Pl., T-7

Sunnyvale, California 94087

Full name of fourth inventor Steven N. Parsoneault

Inventor's signature: \_\_\_\_\_

Date: \_\_\_\_\_

Residence: Scotts Valley, California

Citizenship: USA

Post Office Address: 130 Zinfandel

Scotts Valley, California 95066

Full name of fifth inventor Don J. Macleod

Inventor's signature: \_\_\_\_\_

Date: \_\_\_\_\_

Residence: Santa Cruz, California

Citizenship: UK

Post Office Address: 158 Waugh Ave.

Santa Cruz, California 95065